

LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. NH-1-003(050)113

PCN 18811

COUNTY Kidder and Wells

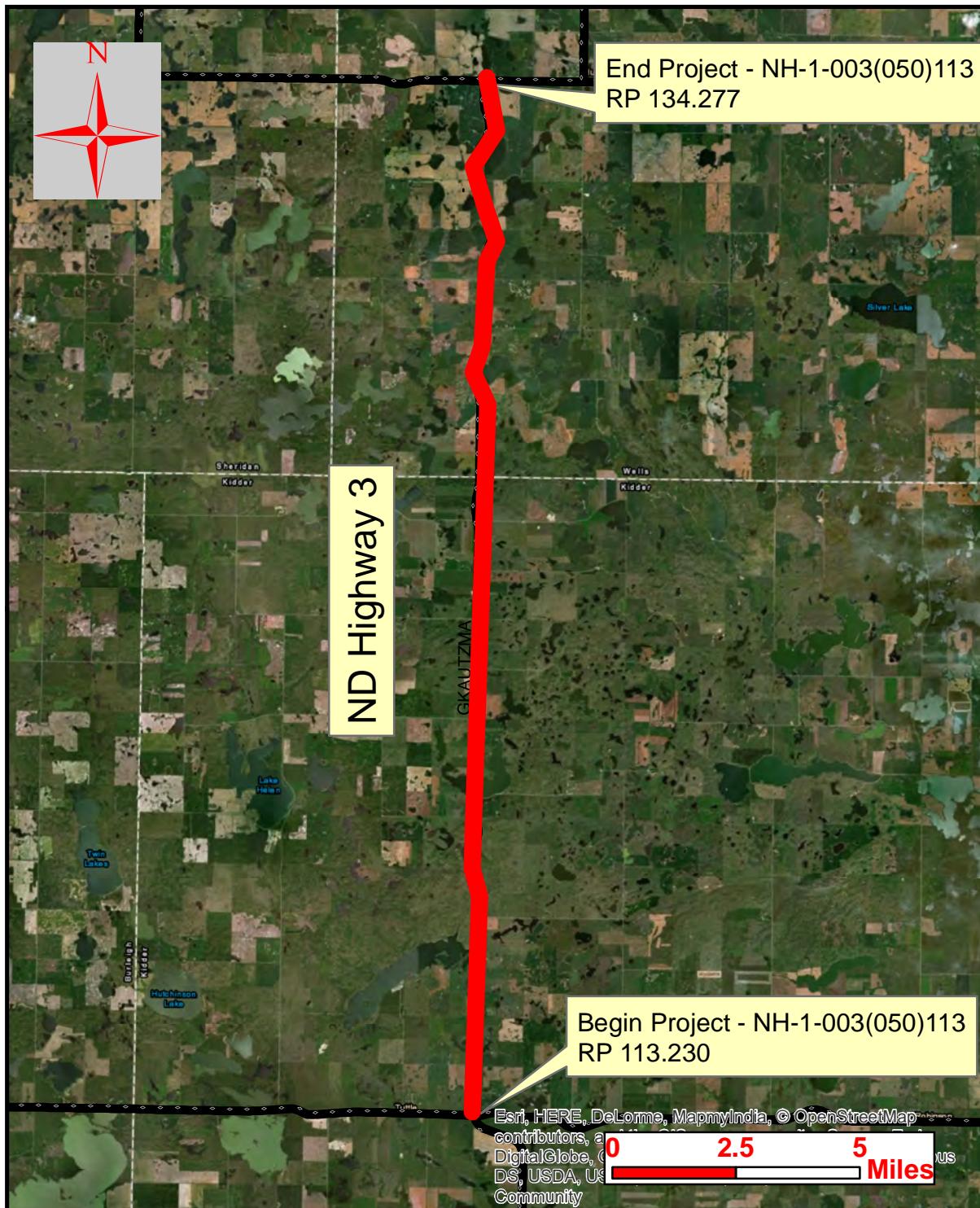
ND Highway 3 From RP 113.230 to RP 134.277



PREPARED BY: Kyle Evert, P.E.

**NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION**

March 2018



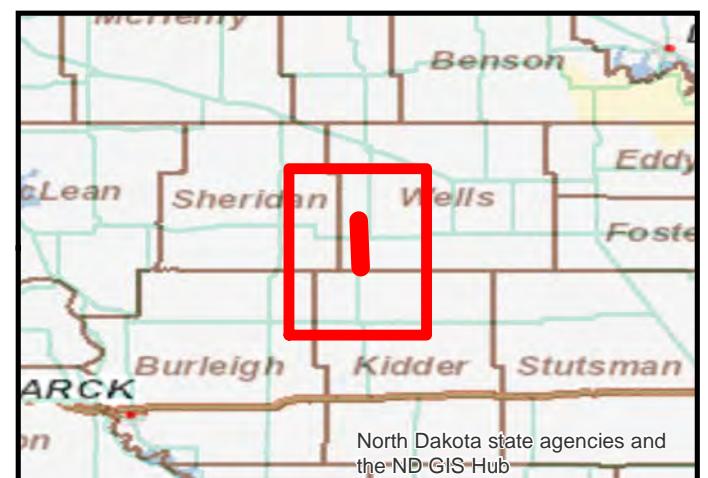
Linear Soils Report and Recommendation

Project: NH-1-003(050)113

PCN: 18811

Scope: Minor Rehabilitation HBP Overlay, Sliver Grading, Realignment, Possible Pipe Replacements

Location: Tuttle N to W Jct 200

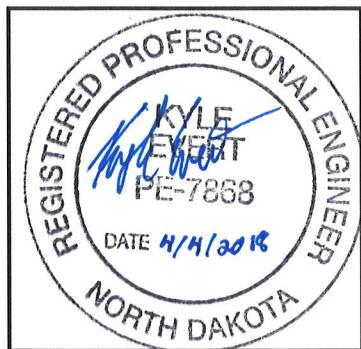


NH-1-003(050)113

Tuttle N to W Jct 200

CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Kyle Evert, Registration number PE-7868 on 4/4/2018 and the original document is stored at the North Dakota Department of Transportation.





Kyle Evert, P.E.

4-4-2018

Date

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Introduction

Location: Tuttle N to W Jct 200

Reference Points: 113.230 to 134.277

Project Length: 21.019 Miles

Proposed Project: Minor Rehabilitation HBP Overlay, Sliver Grading, Grade Raise, Realignment, Possible Pipe Replacements

Investigation Scope: Identified Maintenance Areas Only

Maintenance Review

Date of Maintenance Review(s): 8/30/2017

Materials and Research Person Conducting the Review: Jamie Naumann

District Maintenance Person Conducting Review: Daryl Enzminger, Steele, Section Supervisor

The summary of the identified maintenance areas are shown in the following table. The pavement evaluation log can be found in Appendix B.

Table 1 - Identified Maintenance Areas

Location RP + Feet	Distress Identified	Description	Drilling Required (Yes or No)
113+1218 to 134+1198	Transverse Cracks	Depressed, Longitudinal Cracking-non wheel path	No
115+4300	Culvert	Bump	No
123+0526	Culvert	Bump	No
123+0740	Culvert	Bump	No
129+4100 to 129+4115	Other	Frost Heave	Yes
131+0400 to 131+0700	Other	Frost Heave	Yes
133+0762	Bituminous Patch	Miscellaneous Hand Patch	Yes
133+2700 to 133+2965	Other	Wavy Surface	Yes

Summary of Soil Investigation

The investigation included nineteen borings to a depth of 10' near the areas identified by the District for a possible subcut. The borings were drilled on October 11, 2017. A summary of the locations that were drilled is shown in the following table. Maps of the boring locations are shown in Appendix C. The lab results are included in Appendix E.

Summary of Soil Analysis

The majority of the soils in this area are very uniform and are classified as a lean clay with an AASHTO classification of A-7-6. On average these soils have a liquid limit of approximately 45 and a plasticity index of approximately 25. On average the maximum dry density is approximately 120 lb/ft³ and the optimum water content of 12.5%. The in-place moistures are on average 6% - 10% over optimum. The boring locations from RP

131+0300 to RP 131+0463 are identified as a frost heave. This location has non-plastic silty sand soils.

Soil Sample Distribution

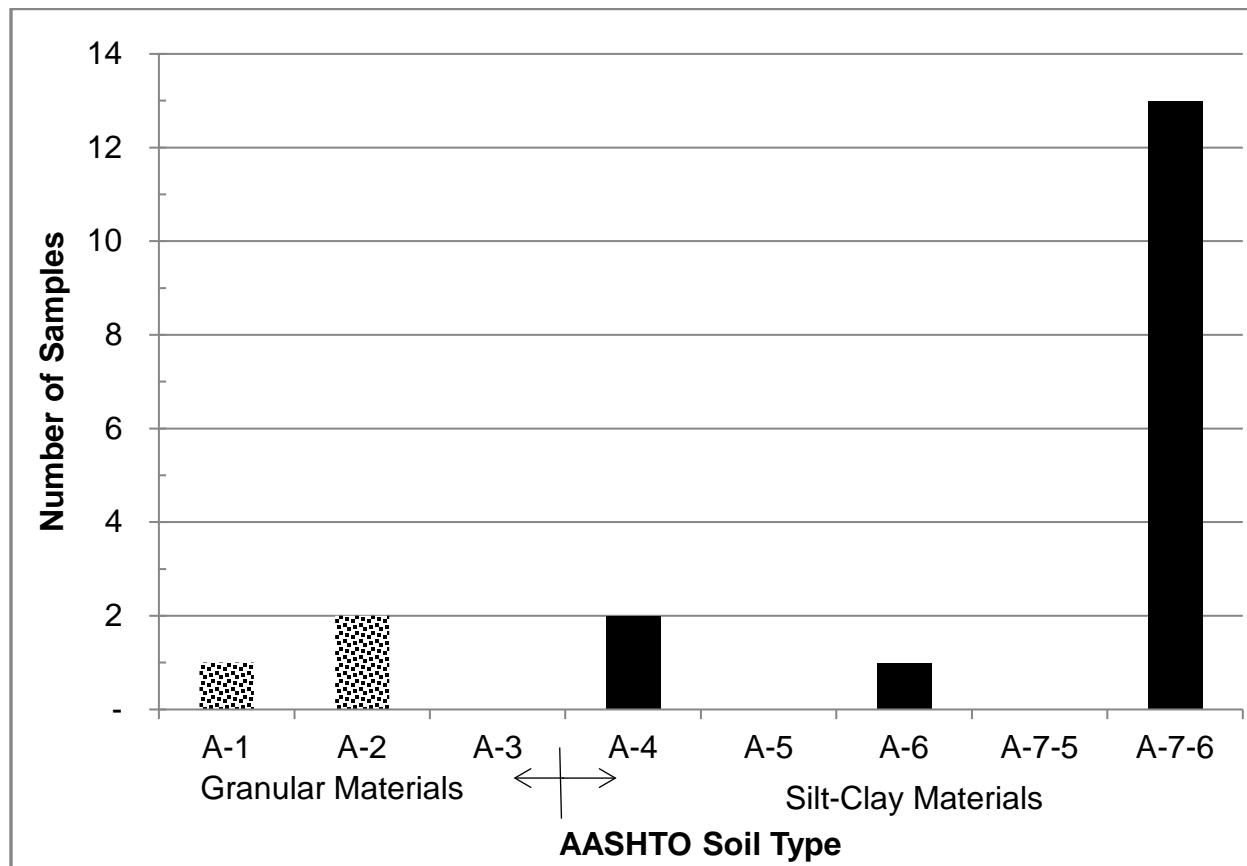


Figure 1 - Soil Sample Distribution

Design Recommendations

The soil analysis from the borings within these locations are uniform in soil excluding the borings located at RP 131+0300 to RP 131+0463. These are silty sand soils that are non-plastic with high silt and sand content. The majority of the soils have a high silt content which is indicative of soils with a high susceptibility to frost heaving. The recommendations are shown in the following table.

Table 2 – Design Recommendations

Location RP + Feet	Distress Identified	Recommendation	Justification
129+4100 to 129+4115	Frost Heave	Subcut	The soil analysis indicates a lean clay, with high moisture content and high silt content. Subcutting this section should alleviate the frost heave in this section.
131+0400 to 131+0420	Frost Heave	Subcut	The soil analysis indicates some sandy silts and lean clays in the area. Subcutting this section should alleviate the frost heave in this section.
133+0762	Bituminous Patch	Subcut	The soil analysis indicates a lean clay, with high moisture content and high silt content. Subcutting this area will improve the pavement section on this soft section of subgrade.
133+2700 to 133+2965	Wavy Surface	Replace Pavement Section	The soils in this location are uniform and do not indicate any problems with the subgrade. Replacing the pavement section will restore the ride for this wavy pavement section.

Design Information

Pavement Reconstruction: Replace the pavement section at 133+2700 to 133+2965 according to the pavement design recommendation.

Compaction Method: T-180

Subgrade Prep: None

Subcut:

Table 3 – Subcut Recommendations

Location RP + Feet	Length (ft)	Depth(in)
129+4000 to 129+4200	200	52
131+0300 to 131+0700	400	52
133+0750 to 133+0800	50	24

This subcut quantity shall be calculated based on the lengths and depths as shown in Table 3 above and adhere to the guidelines stated below.

Remarks: Subcut the specified depth above from the bottom of existing pavement. Place geogrid (Type) G at the bottom of all subcut excavations and backfill with Class 5 aggregate. Place 12" of aggregate on the geogrid prior to compacting. Do not scarify the bottom of the subcut.

Plan Notes

None

The recommendations in this report are based on the scope specified in the Introduction. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, the Geotechnical Engineer must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

**SOIL CLASSIFICATION AND FROST
SUSCEPTIBILITY**

AASHTO Soil Classification System

Table 5.1. AASHTO Classification System

General Classification	Granular materials (35% or less passing No. 200 Sieve (0.075 mm))							Silt-clay Materials More than 35% passing No. 200 Sieve (0.075 mm)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group Classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
(a) Sieve Analysis: Percent Passing											
(i) 2.00 mm (No. 10)	50 max										
(ii) 0.425 mm (No. 40)	30 max	50 max	51 min	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
(iii) 0.075 mm (No. 200)	15 max	25 max	10 max								
(b) Characteristics of fraction passing 0.425 mm (No. 40)											
(i) Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
(ii) Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
(c) Usual types of significant Constituent materials	Stone Fragments Gravel and sand	Fine Sand		Silty or Clayey Gravel Sand				Silty Soils		Clayey Soils	
(d) General rating as subgrade.	Excellent to Good							Fair to Poor			

* If plasticity index is equal to or less than (liquid Limit—30), the soil is A—7—5 (i.e. PL > 30%)
If plasticity index is greater than (Liquid Limit—30), the soil is A—7—6 (i.e. PL < 30%)

Frost Susceptibility Index (Bases on US Army Corps of Engineers)

Frost Class	Frost Susceptibility	Soil Type	Percent Finer than 0.02 mm by weight %
F1	Negligible to Low	• Gravely Soils	3 – 10
F2	Low to Medium	• Gravely Soils • Sands	10 – 20 3 – 15
F3	High	• Gravely Soils • Sands, except very fine silty sands • Clays, PI > 12	Greater than 20 Greater than 15 ---
F4	Very High	• All Silts • Very Fine Silty Sands • Clays, PI > 12 • Varved Clays and other fine-grained banded sediments	--- Greater than 15 --- ---

APPENDIX B

PAVEMENT EVALUATION LOG AND SUBSURFACE INVESTIGATION SCOPE

LINEAR SOILS SURVEY FIELD INVESTIGATION SCOPE

TO:	File
FROM:	Matt Kurle – Geotechnical Section
DATE:	10/5/2017
HIGHWAY:	003.113
PROJECT NUMBER:	SS-1-003(050)113
PCN:	18811
LOCATION:	Tuttle N to W Jct 200
IMPROVEMENT SCOPE:	Minor Rehabilitation – HBP overlay with sliver grading – Possible pipe replacements
SUBJECT:	Linear Soils Survey Subsurface Investigation Scope

We have completed the Maintenance Review of the roadway (attached to this memo) and have circulated it to the Bismarck District for comments. The linear soils survey field investigation scope is based on the improvement strategy for the roadway as per Chapter 7 of the NDDOT Design Manual.

Improvement Strategy: Minor Rehabilitation

Investigation Scope: Identified Areas Only

The following table shows the proposed subsurface investigation scope.

Boring Location	Justification for Boring	Boring Depth	Location
129+4100 to 129+4115	Frost Heave	10 feet	Conduct 3 borings inside the maintenance area and 2 outside the area for a total of 5 borings
131+0400 to 131+0420 (Verify in field actual location)	Frost Heave	10 feet	Conduct 3 borings inside the maintenance area and 2 outside the area for a total of 5 borings
133+0762	Soft Spot	10 feet	Conduct 1 boring within the soft spot (patch) and 1 boring 20 feet from the patch.
133+2700	Uneven Surface	10 feet	Conduct 3 borings inside the maintenance area and 2 outside the area for a total of 5 borings

The following are the associated tasks and dates for the completion of the Linear Soils Survey and Recommendations for this project.

Task	Completion (Anticipated) Date
Maintenance Review with District Maintenance Forces	8/30/2017
District Review of Findings from Previous Task	10/3/2017
Linear Soils Survey Field Work Complete	10/10/2017
Linear Soils Survey Lab Work	12/4/2017
Linear Soils Survey Report	1/1/2018*
*Milestone Task	

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research
SFN 60472 (9-2013)

Sheet
1 of 1

Project Number SS-1-003(050)113	PCN 18811	Date of Survey 8/30/2017
Section Maintenance Contact Daryl Enzminger	Completed By Jamie Naumann	
Highway Reference Points 113+1218 to 134+1198	Surface Type Asphalt	

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
113+1218 to 134+1198	Transv. Cracks	Depressed, Longitudinal Cracking-non wheel path			No
115+4300	Culvert	Bump	Not signed		No
123+0526	Culvert	Bump	Not signed-Covered by rip rap		No
123+0740	Culvert	Bump	Not Signed-Covered by rip rap		No
129+4100 to 129+4115	Other	Frost Heave	Both Lanes	1-2	Yes
131+0400 to 131+0420	Other	Frost Heave (length of area is wrong)	Both Lanes, not signed, Spring in east ditch	3,4,5	Yes
133+0762	Bituminous Patch	Miscellaneous Hand Patch	Soft spot	6,7	Yes
133+2700 to ?	Other	Wavy Surface	Worse in winter	8,9	Yes
	Select One				Select One

Comments

Met with Daryl Enzminger and he indicated these problem areas. Rutting was approximately 0.25" and crack spacing was approximately 40.0'. Last crack seal was in 2016.



1



2



3



4



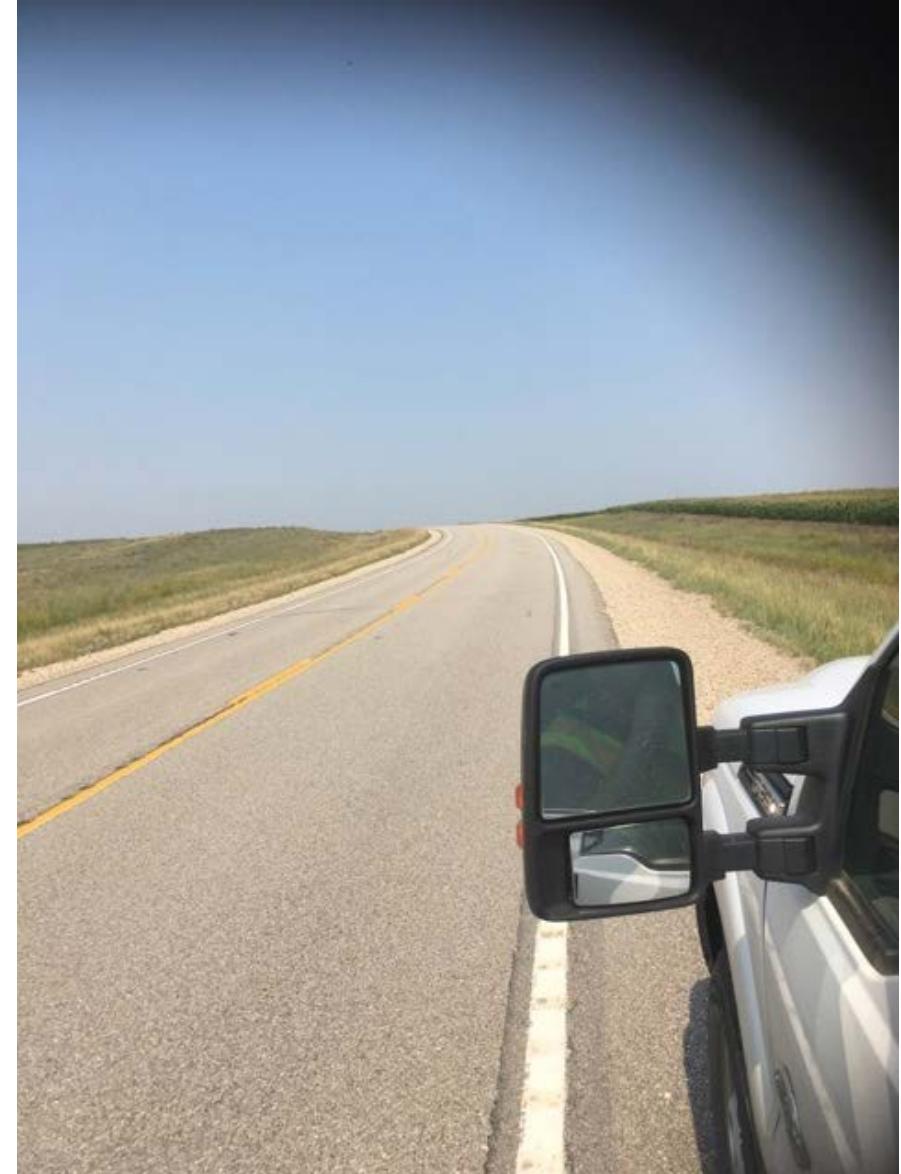
5



6



7



8



APPENDIX C

Boring Locations

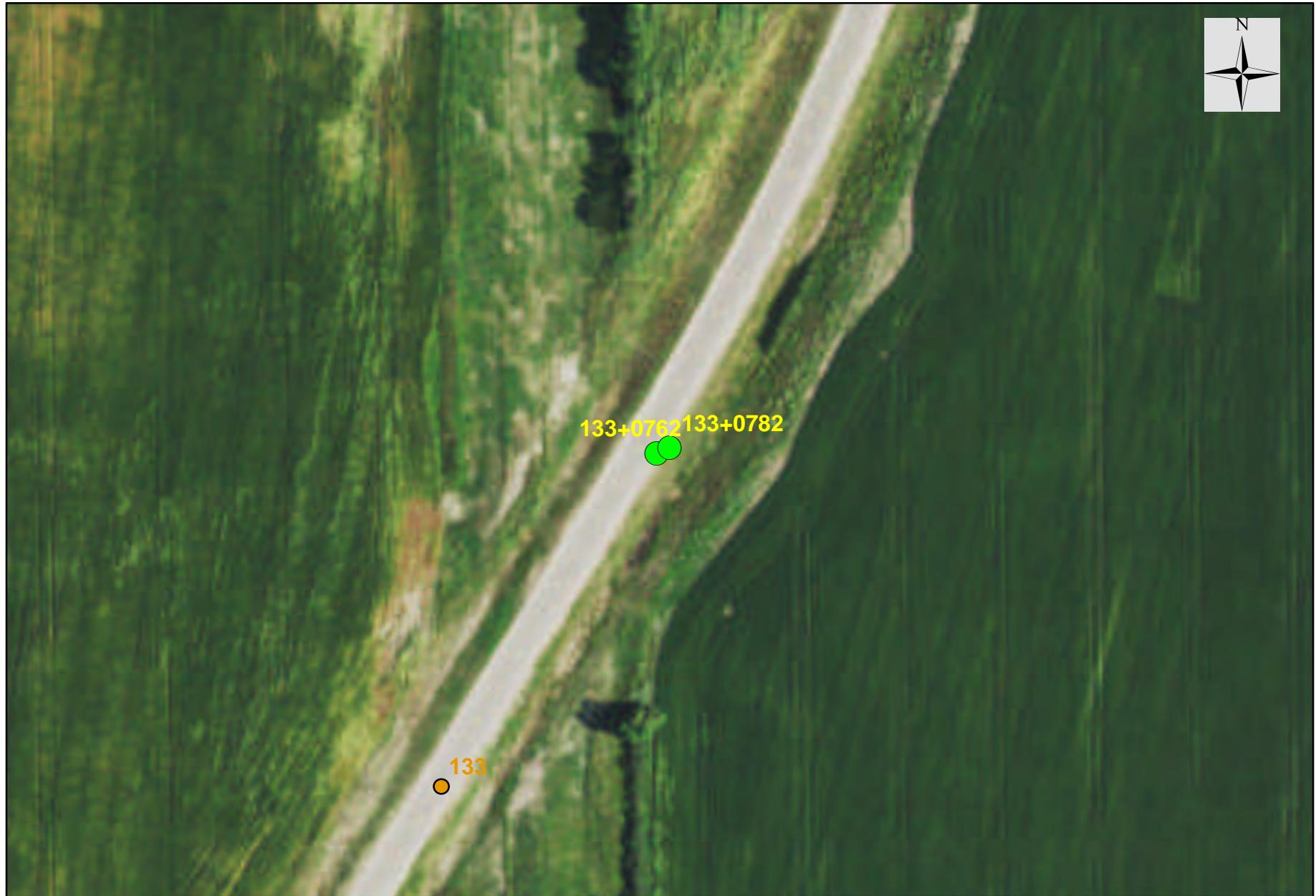


Legend

- Reference Point
- Boring Locations

0 315 630
Feet

Project Number: NH-1-003(050)113



Legend

- Reference Point
- Boring Locations

0 315 630
Feet

Project Number: NH-1-003(050)113



Legend

- Reference Point
- Boring Locations

0 315 630
Feet

Project Number: NH-1-003(050)113



Legend

- Reference Point
- Boring Locations

0 315 630
Feet

Project Number: NH-1-003(050)113

APPENDIX D

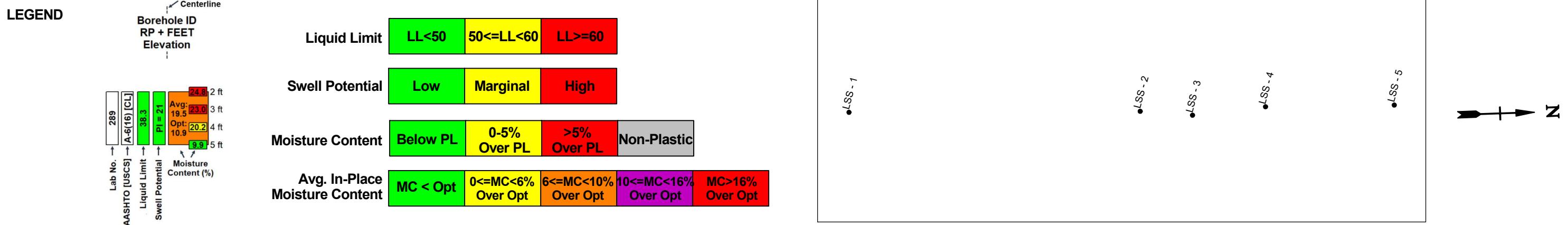
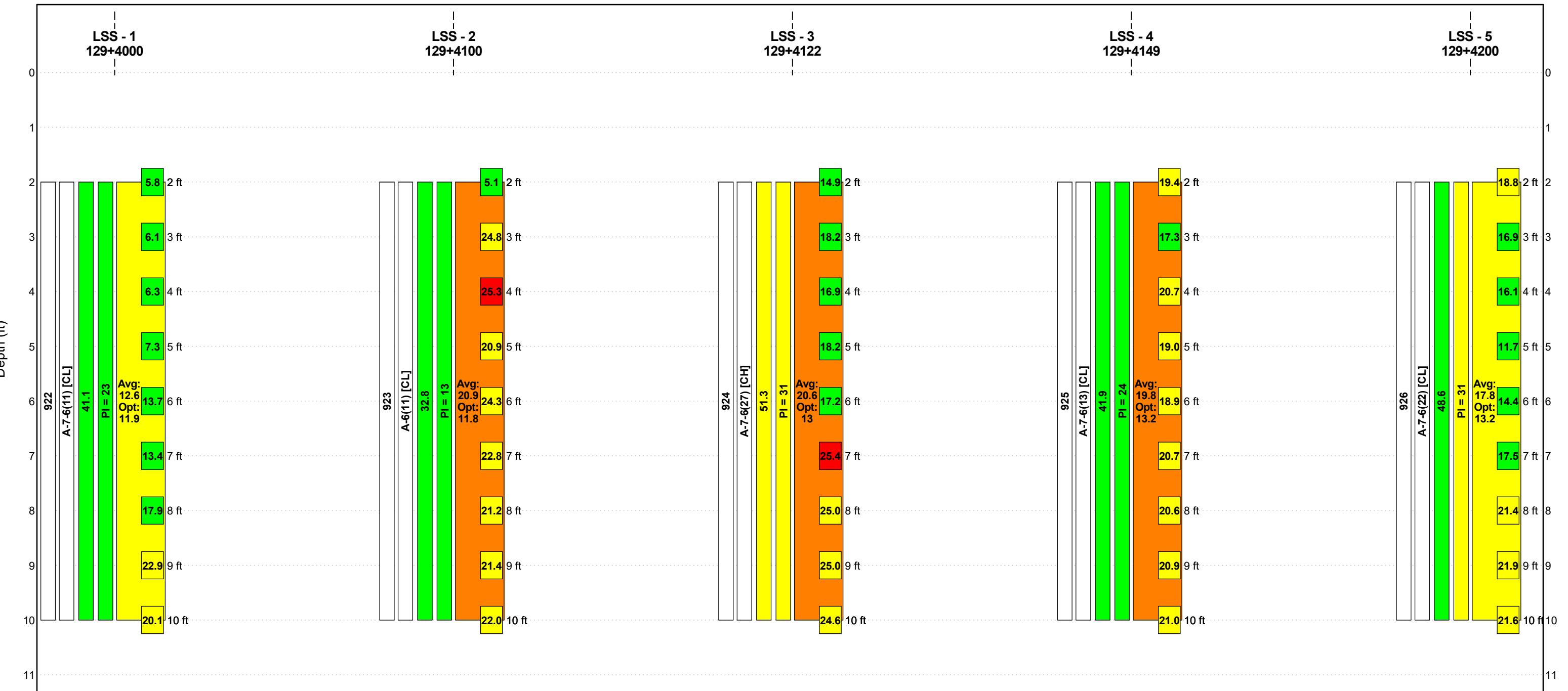
SUMMARY OF SOILS ANALYSIS



NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-1-003(050))113
LOCATION Kidder County

PCN 18811

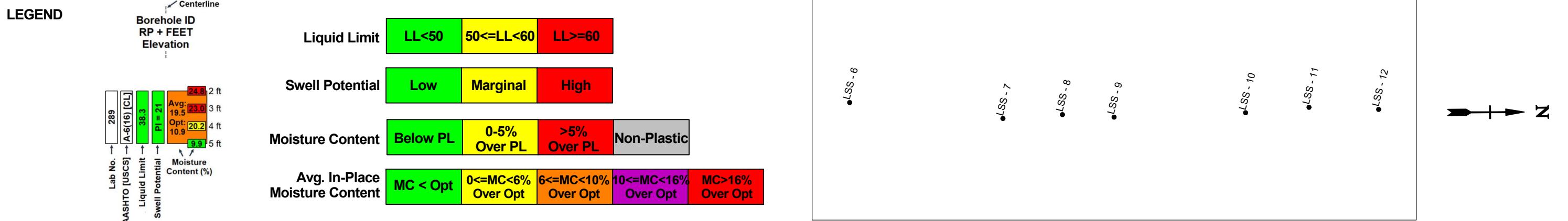
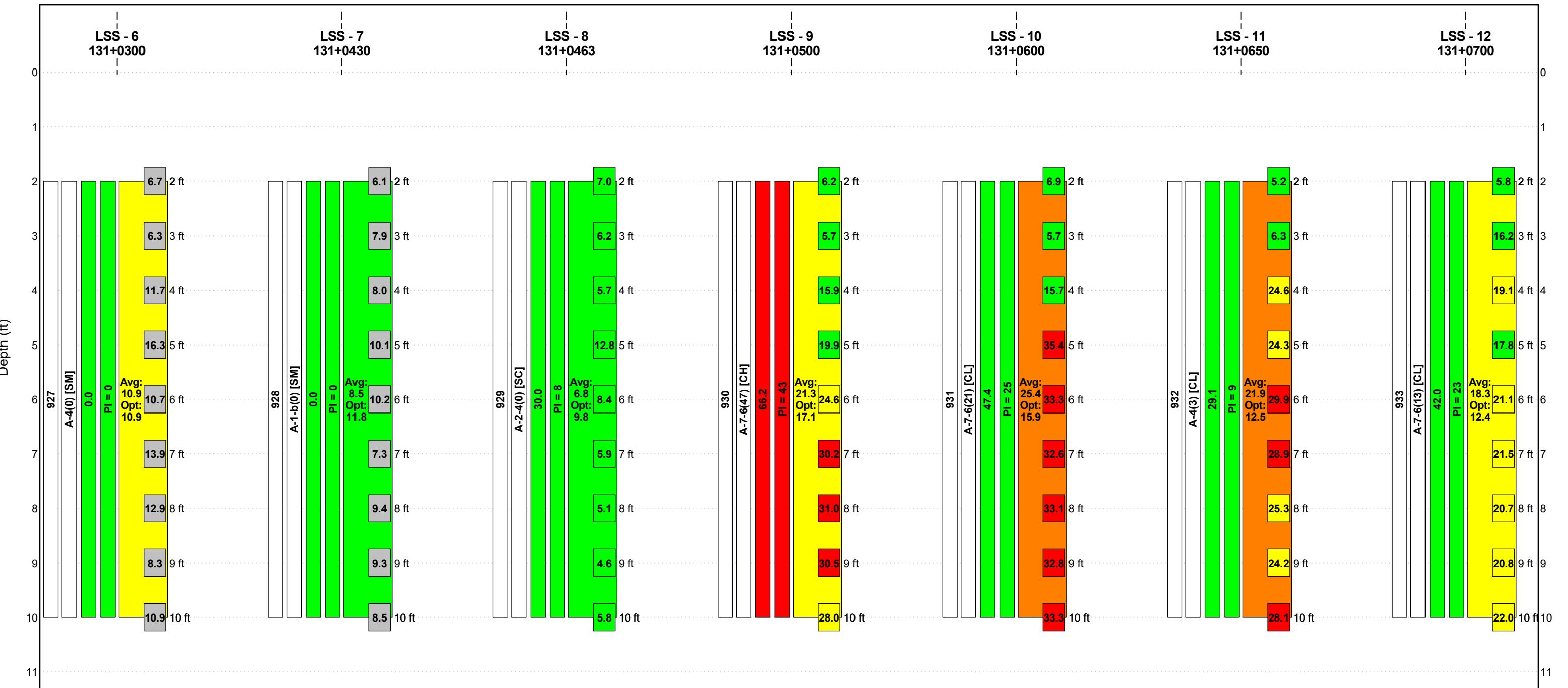


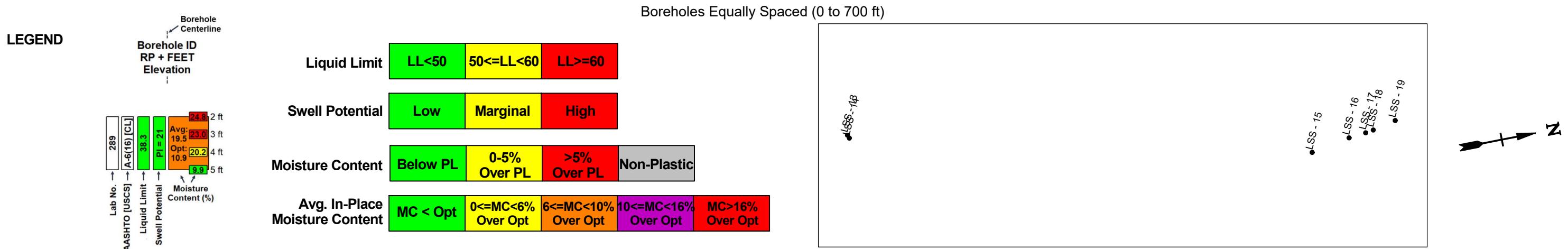
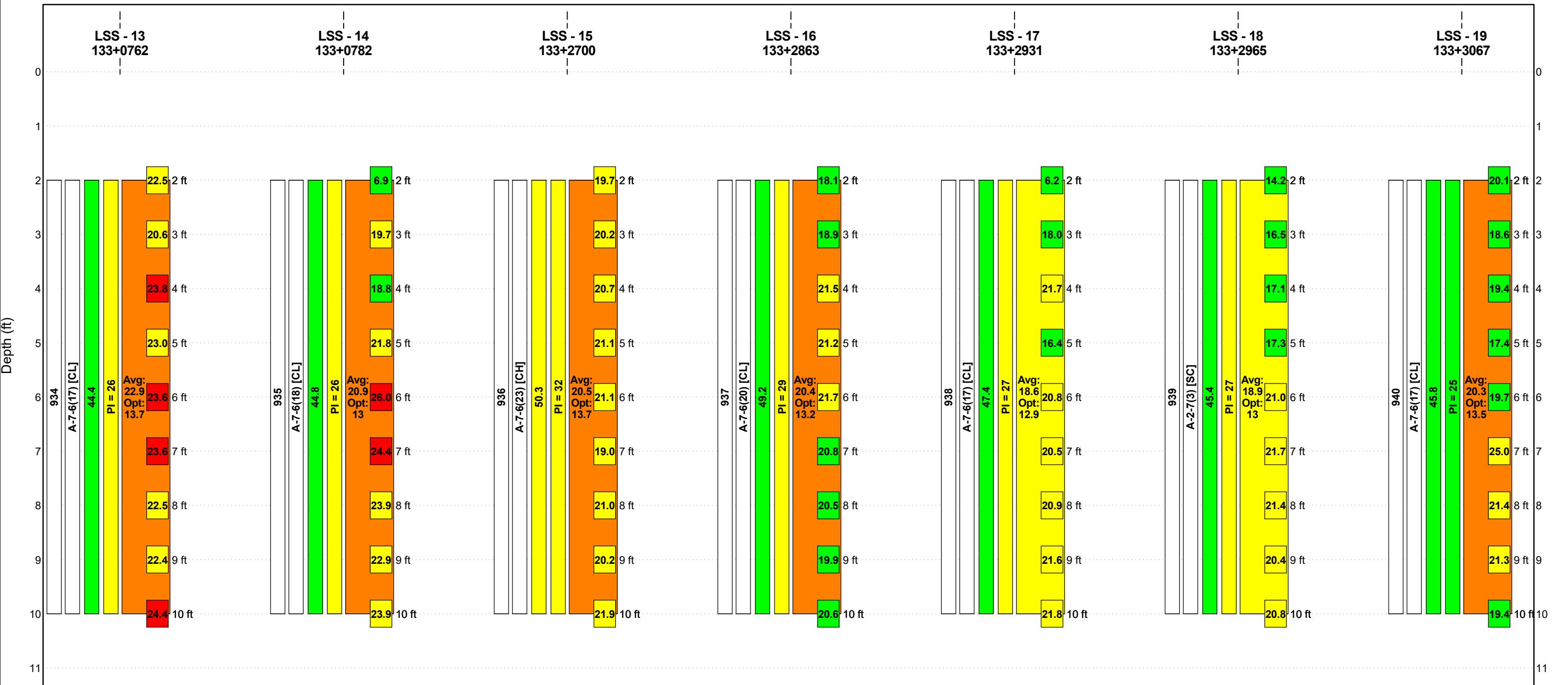


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APPENDIX E

LAB RESULTS



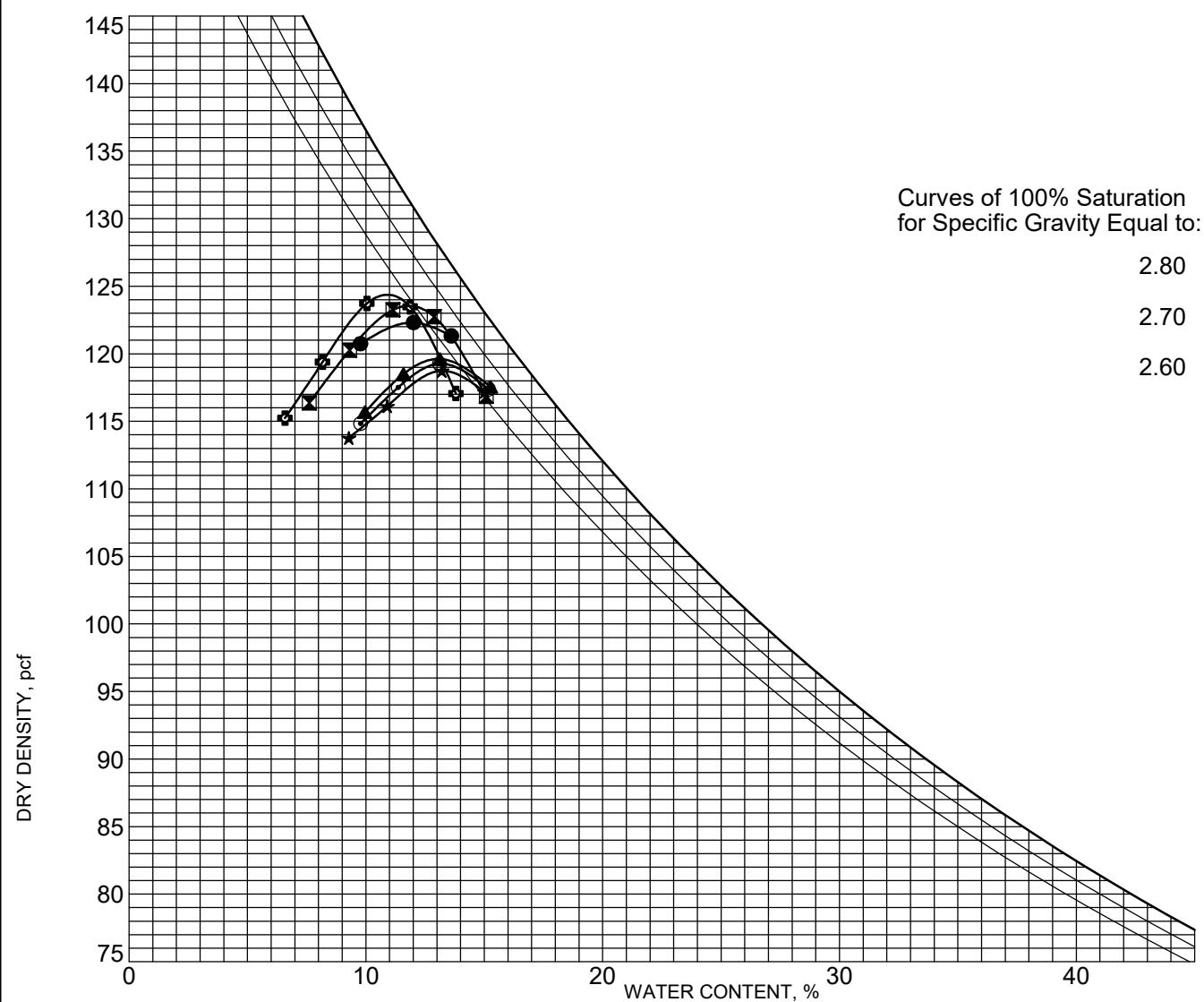
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MOISTURE-DENSITY RELATIONSHIP

PROJECT NUMBER SS-1-003(050))113

LOCATION Kidder County

PCN 18811



BOREHOLE	DEPTH	AASHTO Classification	USCS Description
● LSS - 1	2.0	A-7-6 (11)	SANDY LEAN CLAY(CL)
▣ LSS - 2	2.0	A-6 (11)	LEAN CLAY(CL)
▲ LSS - 3	2.0	A-7-6 (27)	FAT CLAY(CH)
★ LSS - 4	2.0	A-7-6 (13)	SANDY LEAN CLAY(CL)
◎ LSS - 5	2.0	A-7-6 (22)	LEAN CLAY with SAND(CL)
◆ LSS - 6	2.0	A-4 (0)	SILTY SAND(SM)

BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
● LSS - 1	2.0	AASHTO T-180 Method A	41	18	23	122.3 PCF	11.9 %
▣ LSS - 2	2.0	AASHTO T-180 Method A	33	20	13	123.5 PCF	11.8 %
▲ LSS - 3	2.0	AASHTO T-180 Method A	51	20	31	119.6 PCF	13.0 %
★ LSS - 4	2.0	AASHTO T-180 Method A	42	18	24	118.7 PCF	13.2 %
◎ LSS - 5	2.0	AASHTO T-180 Method A	49	18	31	119.3 PCF	13.2 %
◆ LSS - 6	2.0	AASHTO T-180 Method A	NP	NP	NP	124.4 PCF	10.9 %



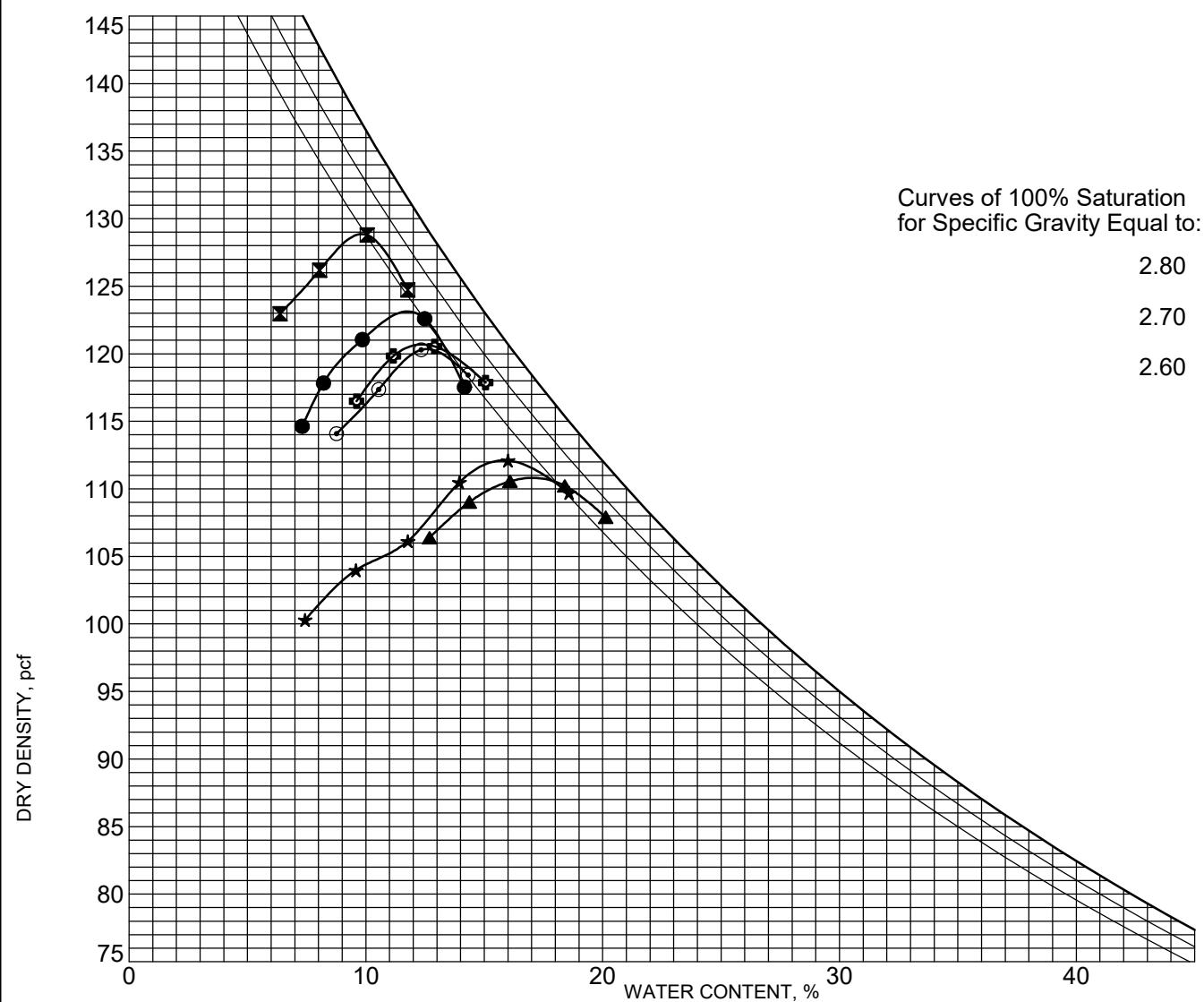
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MOISTURE-DENSITY RELATIONSHIP

PROJECT NUMBER SS-1-003(050))113

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BOREHOLE	DEPTH	AASHTO Classification	USCS Description			
● LSS - 7	2.0	A-1-b (0)	SILTY SAND with GRAVEL(SM)			
▣ LSS - 8	2.0	A-2-4 (0)	CLAYEY SAND with GRAVEL(SC)			
▲ LSS - 9	2.0	A-7-6 (47)	FAT CLAY(CH)			
★ LSS - 10	2.0	A-7-6 (21)	LEAN CLAY with SAND(CL)			
◎ LSS - 11	2.0	A-4 (3)	SANDY LEAN CLAY(CL)			
◆ LSS - 12	2.0	A-7-6 (13)	SANDY LEAN CLAY(CL)			

BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
● LSS - 7	2.0	AASHTO T-180 Method A	NP	NP	NP	123.1 PCF	11.8 %
▣ LSS - 8	2.0	AASHTO T-180 Method A	30	22	8	128.9 PCF	9.8 %
▲ LSS - 9	2.0	AASHTO T-180 Method A	66	24	42	110.8 PCF	17.1 %
★ LSS - 10	2.0	AASHTO T-180 Method A	47	23	24	112.1 PCF	15.9 %
◎ LSS - 11	2.0	AASHTO T-180 Method A	29	21	8	120.3 PCF	12.5 %
◆ LSS - 12	2.0	AASHTO T-180 Method A	42	19	23	120.7 PCF	12.4 %



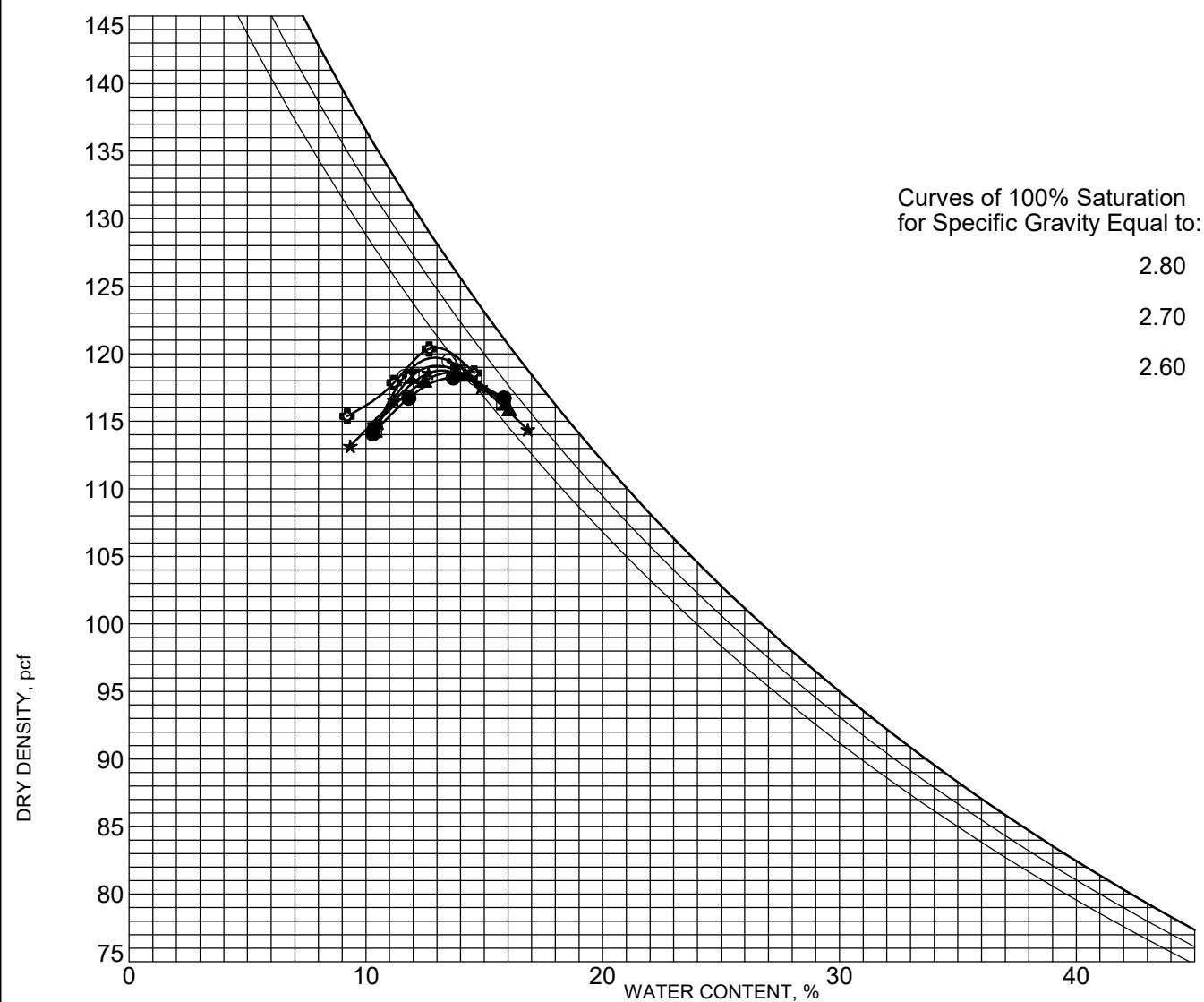
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BOREHOLE	DEPTH	AASHTO Classification	USCS Description
● LSS - 13	2.0	A-7-6 (17)	LEAN CLAY with SAND(CL)
▣ LSS - 14	2.0	A-7-6 (18)	LEAN CLAY with SAND(CL)
▲ LSS - 15	2.0	A-7-6 (23)	FAT CLAY with SAND(CH)
★ LSS - 16	2.0	A-7-6 (20)	LEAN CLAY with SAND(CL)
◎ LSS - 17	2.0	A-7-6 (17)	SANDY LEAN CLAY(CL)
◆ LSS - 18	2.0	A-2-7 (3)	CLAYEY SAND(SC)

BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
● LSS - 13	2.0	AASHTO T-180 Method A	44	18	26	118.2 PCF	13.7 %
▣ LSS - 14	2.0	AASHTO T-180 Method A	45	19	26	119.1 PCF	13.0 %
▲ LSS - 15	2.0	AASHTO T-180 Method A	50	19	31	118.6 PCF	13.7 %
★ LSS - 16	2.0	AASHTO T-180 Method A	49	21	28	118.8 PCF	13.2 %
◎ LSS - 17	2.0	AASHTO T-180 Method A	47	20	27	119.7 PCF	12.9 %
◆ LSS - 18	2.0	AASHTO T-180 Method A	45	19	26	120.4 PCF	13.0 %



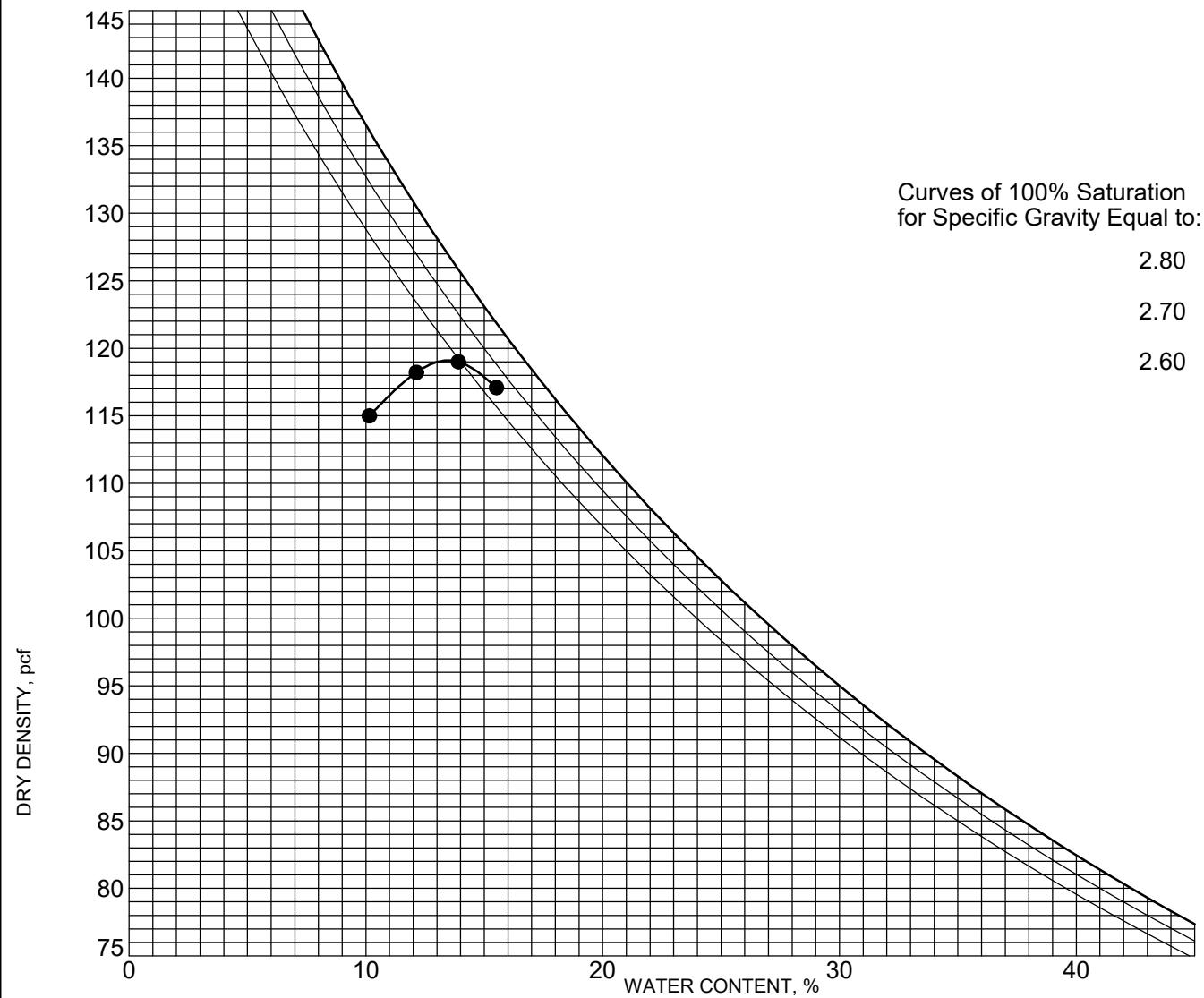
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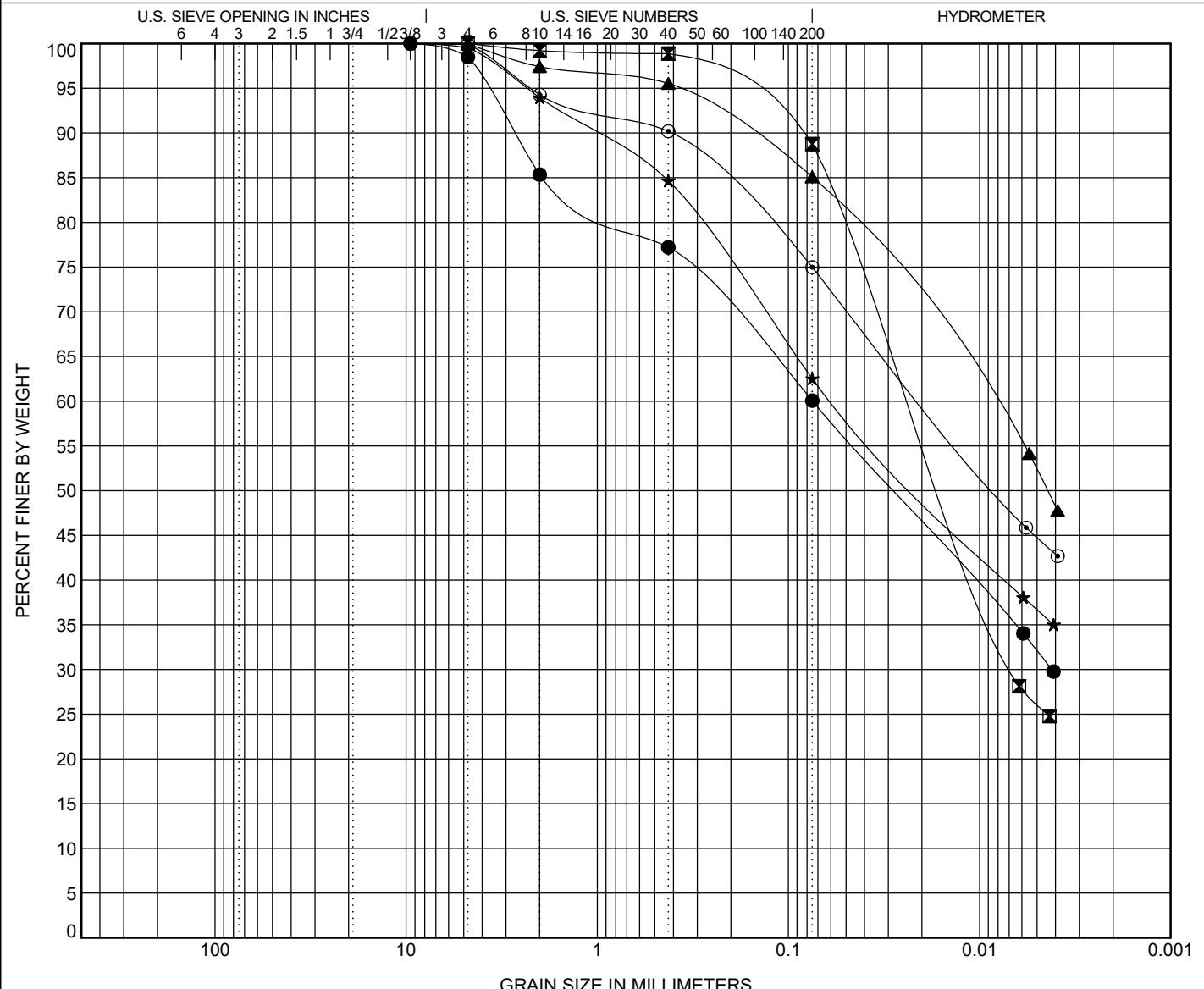
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BISMARCK, ND 58504

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER SS-1-003(050)113

LOCATION Kidder County

PCN 18811



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● LSS - 1	2.0	A-7-6	(11)		CL		41	18	23		
■ LSS - 2	2.0	A-6	(11)		CL		33	20	13		
▲ LSS - 3	2.0	A-7-6	(27)		CH		51	20	31		
★ LSS - 4	2.0	A-7-6	(13)		CL		42	18	24		
○ LSS - 5	2.0	A-7-6	(22)		CL		49	18	31		

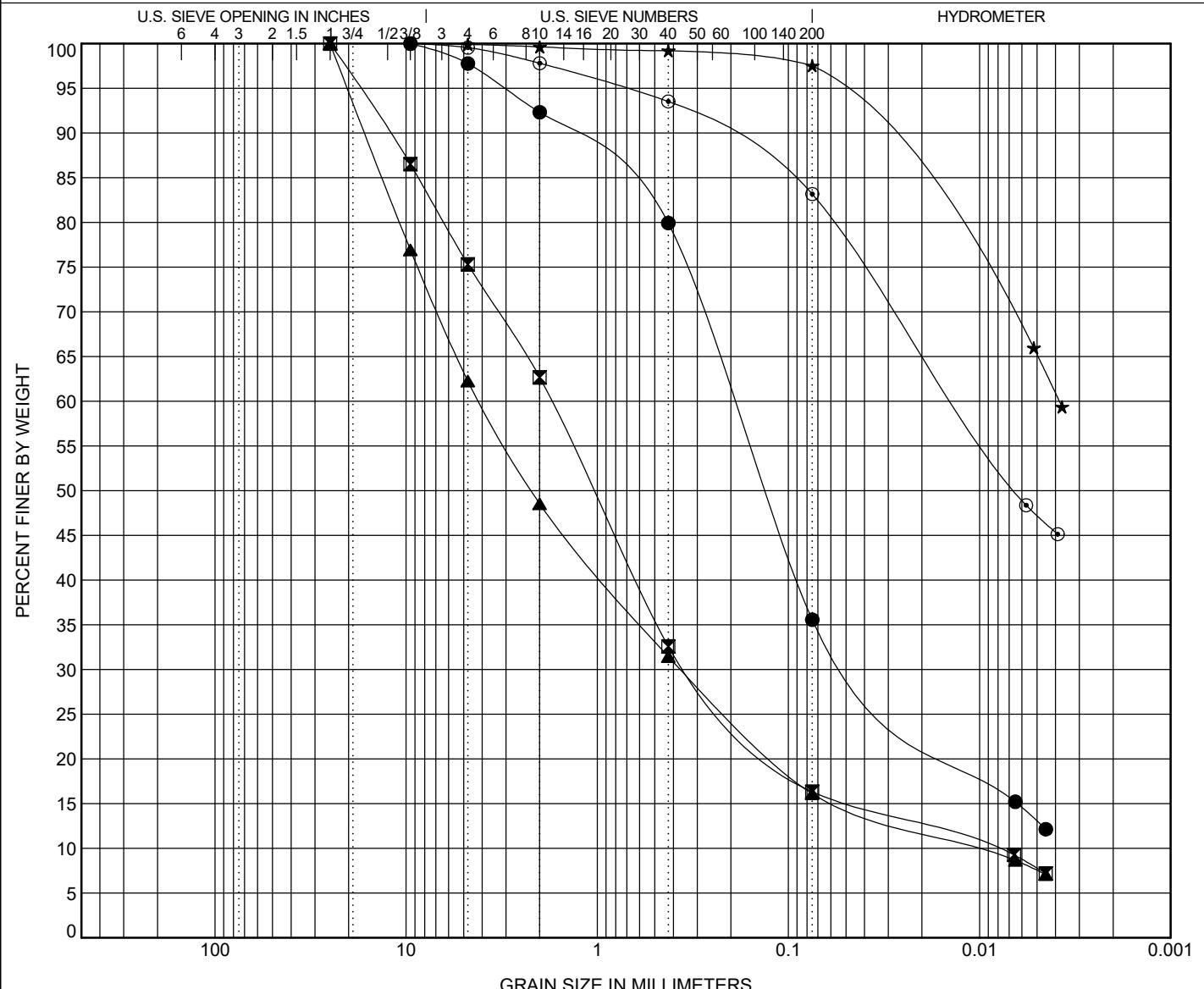
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 1	2.0	9.5	0.074	0.004		1.5	38.4	28.0	32.1
■ LSS - 2	2.0	4.75	0.023	0.007		0.0	11.2	62.6	26.2
▲ LSS - 3	2.0	4.75	0.009			0.0	14.9	32.7	52.4
★ LSS - 4	2.0	9.5	0.058			0.5	37.0	25.9	36.7
○ LSS - 5	2.0	9.5	0.02			0.1	24.9	30.2	44.8

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER SS-1-003(050)113

LOCATION Kidder County

PCN 18811



COBBLES	GRAVEL		SAND			SILT OR CLAY				
	coarse	fine	coarse	medium	fine	LL	PL	PI	Cc	Cu
● LSS - 6	2.0	A-4 (0)					SM	NP	NP	
☒ LSS - 7	2.0	A-1-b (0)					SM	NP	NP	7.05 205.73
▲ LSS - 8	2.0	A-2-4 (0)					SC	30	22	8 3.13 408.75
★ LSS - 9	2.0	A-7-6 (47)					CH	66	24	42
○ LSS - 10	2.0	A-7-6 (21)					CL	47	23	24
BOREHOLE	DEPTH	AASHTO Classification			USCS Classification			D100	D60	D30
● LSS - 6	2.0	A-4 (0)			SM			9.5	0.195	0.038
☒ LSS - 7	2.0	A-1-b (0)			SM			25	1.743	0.323
▲ LSS - 8	2.0	A-2-4 (0)			SC			25	4.121	0.361
★ LSS - 9	2.0	A-7-6 (47)			CH			9.5	0.004	
○ LSS - 10	2.0	A-7-6 (21)			CL			9.5	0.013	
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	
● LSS - 6	2.0	9.5	0.195	0.038		2.2	62.2	22.5	13.0	
☒ LSS - 7	2.0	25	1.743	0.323	0.008	24.7	59.0	8.6	7.8	
▲ LSS - 8	2.0	25	4.121	0.361	0.01	37.7	46.1	8.6	7.5	
★ LSS - 9	2.0	9.5	0.004			0.1	2.4	32.3	65.2	
○ LSS - 10	2.0	9.5	0.013			0.5	16.4	35.9	47.3	



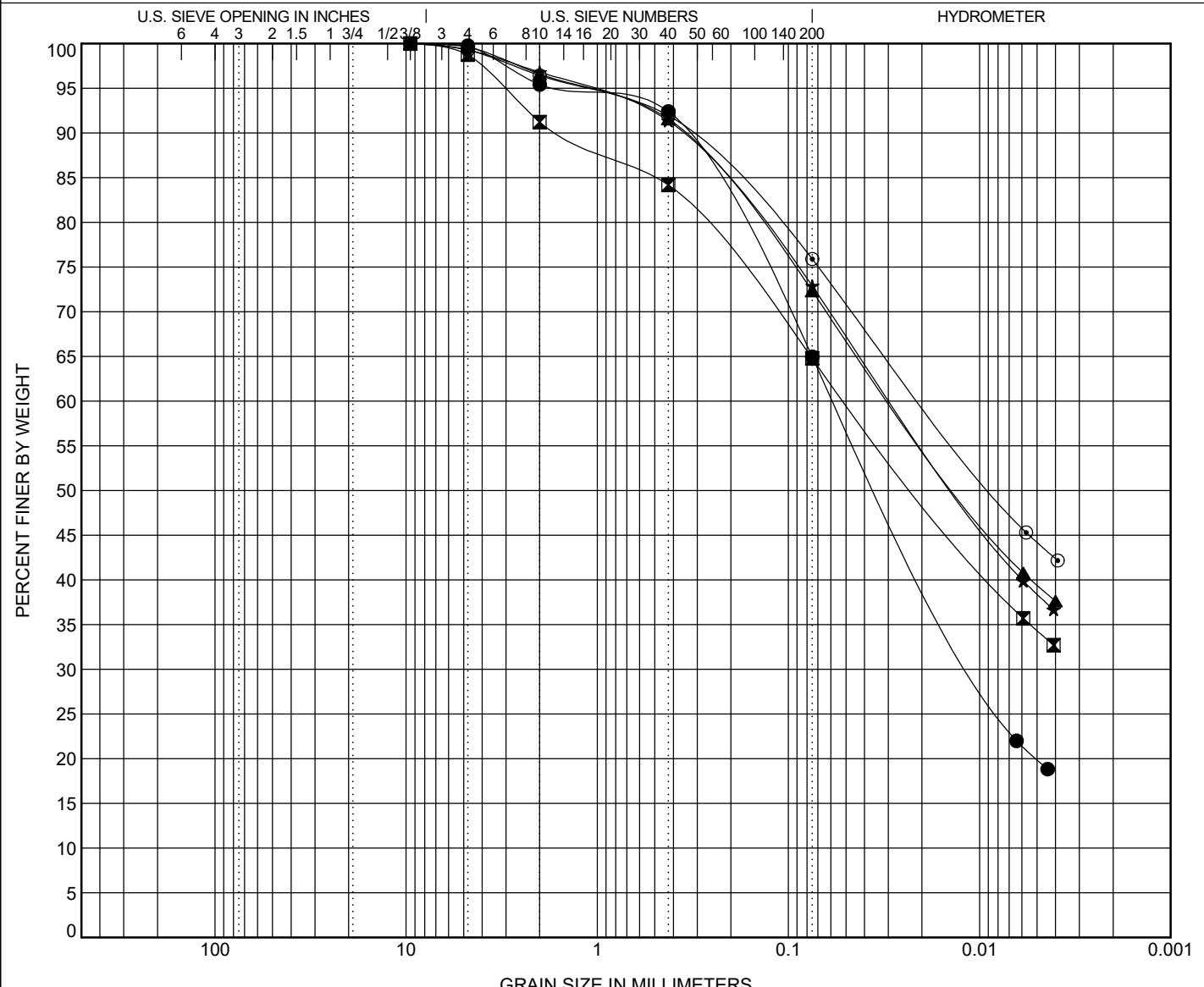
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER SS-1-003(050))113

LOCATION Kidder County

PCN 18811



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

GRAIN SIZE - 20171219.GDT - 3/20/18 15:27 - F:\LAB\PROJECTS\GINTNH-1-003(050)\113.GPJ

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● LSS - 11	2.0	A-4	(3)		CL		29	21	8		
■ LSS - 12	2.0	A-7-6	(13)		CL		42	19	23		
▲ LSS - 13	2.0	A-7-6	(17)		CL		44	18	26		
★ LSS - 14	2.0	A-7-6	(18)		CL		45	19	26		
○ LSS - 15	2.0	A-7-6	(23)		CH		50	19	31		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● LSS - 11	2.0	9.5	0.056	0.01		0.2	34.8	45.1	19.9		
■ LSS - 12	2.0	9.5	0.049			1.2	34.0	30.4	34.3		
▲ LSS - 13	2.0	9.5	0.028			0.4	27.3	32.9	39.4		
★ LSS - 14	2.0	9.5	0.028			0.7	26.4	34.5	38.4		
○ LSS - 15	2.0	9.5	0.02			0.7	23.4	31.7	44.2		



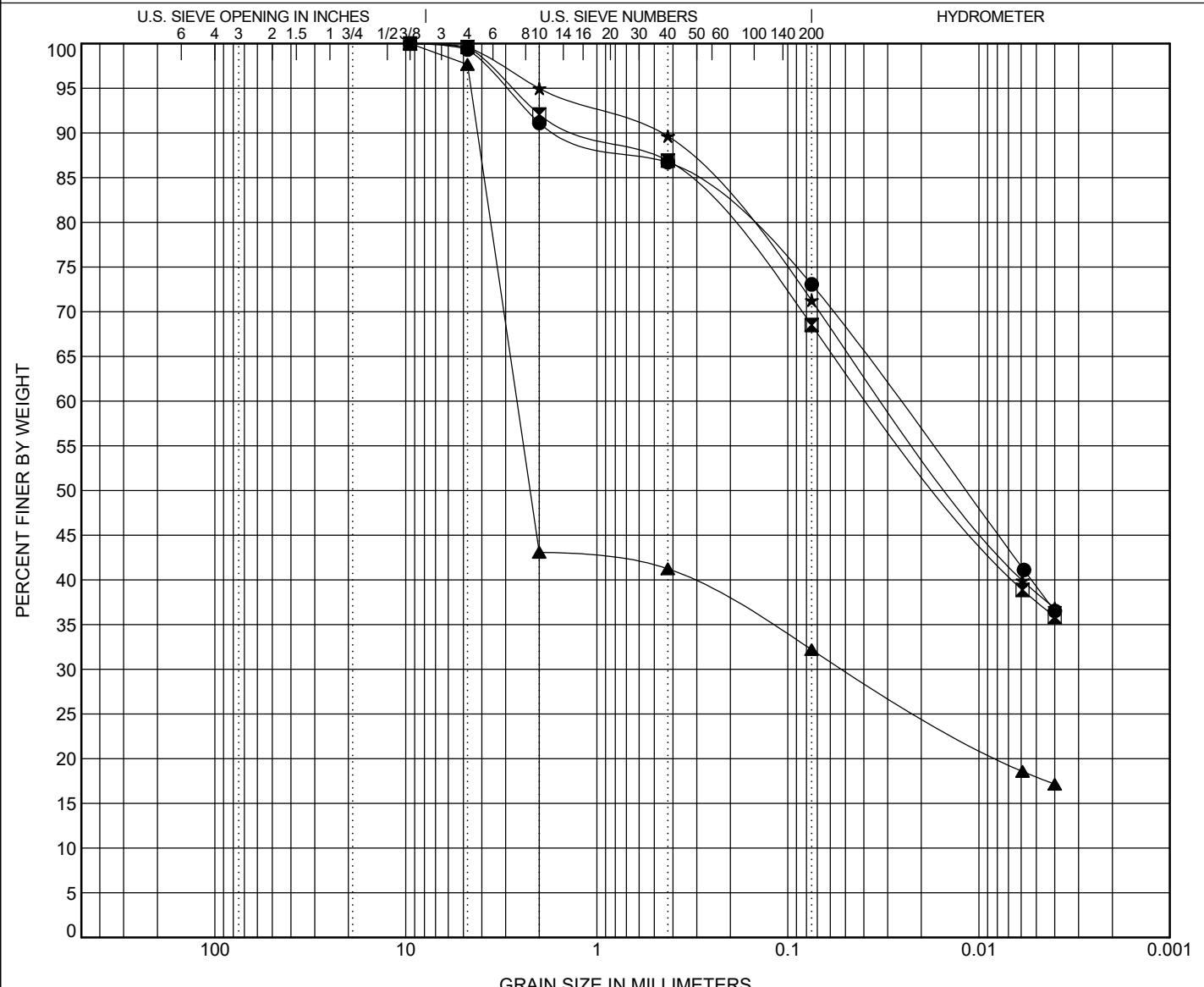
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER SS-1-003(050)113

LOCATION Kidder County

PCN 18811



GRAIN SIZE - 20171219.GDT - 3/20/18 15:27 - F:\LAB\PROJECTS\GINTN\H-1-003(050)113.GPJ

COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● LSS - 16	2.0	A-7-6	(20)		CL		49	21	28		
◻ LSS - 17	2.0	A-7-6	(17)		CL		47	20	27		
▲ LSS - 18	2.0	A-2-7	(3)		SC		45	19	26		
★ LSS - 19	2.0	A-7-6	(17)		CL		46	21	25		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● LSS - 16	2.0	9.5	0.026			0.7	26.3	33.8	39.3
◻ LSS - 17	2.0	9.5	0.036			0.4	31.1	30.9	37.6
▲ LSS - 18	2.0	9.5	2.615	0.05		2.3	65.5	14.2	18.0
★ LSS - 19	2.0	9.5	0.03			0.4	28.3	32.7	38.6



PROJECT NUMBER SS-1-003(050)113

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Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Classification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
LSS - 1	2.0	41	18	23	9.5	60	A-7-6 (11)	CL	5.8				
LSS - 1	3.0								6.1				
LSS - 1	4.0								6.3				
LSS - 1	5.0								7.3				
LSS - 1	6.0								13.7				
LSS - 1	7.0								13.4				
LSS - 1	8.0								17.9				
LSS - 1	9.0								22.9				
LSS - 1	10.0								20.1				
LSS - 2	2.0	33	20	13	4.75	89	A-6 (11)	CL	5.1				
LSS - 2	3.0								24.8				
LSS - 2	4.0								25.3				
LSS - 2	5.0								20.9				
LSS - 2	6.0								24.3				
LSS - 2	7.0								22.8				
LSS - 2	8.0								21.2				
LSS - 2	9.0								21.4				
LSS - 2	10.0								22.0				
LSS - 3	2.0	51	20	31	4.75	85	A-7-6 (27)	CH	14.9				
LSS - 3	3.0								18.2				
LSS - 3	4.0								16.9				
LSS - 3	5.0								18.2				
LSS - 3	6.0								17.2				
LSS - 3	7.0								25.4				
LSS - 3	8.0								25.0				
LSS - 3	9.0								25.0				
LSS - 3	10.0								24.6				
LSS - 4	2.0	42	18	24	9.5	63	A-7-6 (13)	CL	19.4				
LSS - 4	3.0								17.3				
LSS - 4	4.0								20.7				
LSS - 4	5.0								19.0				
LSS - 4	6.0								18.9				
LSS - 4	7.0								20.7				
LSS - 4	8.0								20.6				
LSS - 4	9.0								20.9				
LSS - 4	10.0								21.0				
LSS - 5	2.0	49	18	31	9.5	75	A-7-6 (22)	CL	18.8				
LSS - 5	3.0								16.9				
LSS - 5	4.0								16.1				
LSS - 5	5.0								11.7				
LSS - 5	6.0								14.4				
LSS - 5	7.0								17.5				
LSS - 5	8.0								21.4				



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SUMMARY OF LABORATORY RESULTS

PAGE 2 OF 4

PROJECT NUMBER SS-1-003(050)113

LOCATION Kidder County

PCN

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Classification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
LSS - 5	9.0								21.9				
LSS - 5	10.0								21.6				
LSS - 6	2.0	NP	NP	NP	9.5	36	A-4 (0)	SM	6.7				
LSS - 6	3.0								6.3				
LSS - 6	4.0								11.7				
LSS - 6	5.0								16.3				
LSS - 6	6.0								10.7				
LSS - 6	7.0								13.9				
LSS - 6	8.0								12.9				
LSS - 6	9.0								8.3				
LSS - 6	10.0								10.9				
LSS - 7	2.0	NP	NP	NP	25	16	A-1-b (0)	SM	6.1				
LSS - 7	3.0								7.9				
LSS - 7	4.0								8.0				
LSS - 7	5.0								10.1				
LSS - 7	6.0								10.2				
LSS - 7	7.0								7.3				
LSS - 7	8.0								9.4				
LSS - 7	9.0								9.3				
LSS - 7	10.0								8.5				
LSS - 8	2.0	30	22	8	25	16	A-2-4 (0)	SC	7.0				
LSS - 8	3.0								6.2				
LSS - 8	4.0								5.7				
LSS - 8	5.0								12.8				
LSS - 8	6.0								8.4				
LSS - 8	7.0								5.9				
LSS - 8	8.0								5.1				
LSS - 8	9.0								4.6				
LSS - 8	10.0								5.8				
LSS - 9	2.0	66	24	42	9.5	98	A-7-6 (47)	CH	6.2				
LSS - 9	3.0								5.7				
LSS - 9	4.0								15.9				
LSS - 9	5.0								19.9				
LSS - 9	6.0								24.6				
LSS - 9	7.0								30.2				
LSS - 9	8.0								31.0				
LSS - 9	9.0								30.5				
LSS - 9	10.0								28.0				
LSS - 10	2.0	47	23	24	9.5	83	A-7-6 (21)	CL	6.9				
LSS - 10	3.0								5.7				
LSS - 10	4.0								15.7				
LSS - 10	5.0								35.4				
LSS - 10	6.0								33.3				



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PROJECT NUMBER SS-1-003(050)113

LOCATION Kidder County

PCN

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Classification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
LSS - 10	7.0								32.6				
LSS - 10	8.0								33.1				
LSS - 10	9.0								32.8				
LSS - 10	10.0								33.3				
LSS - 11	2.0	29	21	8	9.5	65	A-4 (3)	CL	5.2				
LSS - 11	3.0								6.3				
LSS - 11	4.0								24.6				
LSS - 11	5.0								24.3				
LSS - 11	6.0								29.9				
LSS - 11	7.0								28.9				
LSS - 11	8.0								25.3				
LSS - 11	9.0								24.2				
LSS - 11	10.0								28.1				
LSS - 12	2.0	42	19	23	9.5	65	A-7-6 (13)	CL	5.8				
LSS - 12	3.0								16.2				
LSS - 12	4.0								19.1				
LSS - 12	5.0								17.8				
LSS - 12	6.0								21.1				
LSS - 12	7.0								21.5				
LSS - 12	8.0								20.7				
LSS - 12	9.0								20.8				
LSS - 12	10.0								22.0				
LSS - 13	2.0	44	18	26	9.5	72	A-7-6 (17)	CL	22.5				
LSS - 13	3.0								20.6				
LSS - 13	4.0								23.8				
LSS - 13	5.0								23.0				
LSS - 13	6.0								23.6				
LSS - 13	7.0								23.6				
LSS - 13	8.0								22.5				
LSS - 13	9.0								22.4				
LSS - 13	10.0								24.4				
LSS - 14	2.0	45	19	26	9.5	73	A-7-6 (18)	CL	6.9				
LSS - 14	3.0								19.7				
LSS - 14	4.0								18.8				
LSS - 14	5.0								21.8				
LSS - 14	6.0								26.0				
LSS - 14	7.0								24.4				
LSS - 14	8.0								23.9				
LSS - 14	9.0								22.9				
LSS - 14	10.0								23.9				
LSS - 15	2.0	50	19	31	9.5	76	A-7-6 (23)	CH	19.7				
LSS - 15	3.0								20.2				
LSS - 15	4.0								20.7				



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SUMMARY OF LABORATORY RESULTS

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PROJECT NUMBER SS-1-003(050)113

LOCATION Kidder County

PCN

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Classification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
LSS - 15	5.0								21.1				
LSS - 15	6.0								21.1				
LSS - 15	7.0								19.0				
LSS - 15	8.0								21.0				
LSS - 15	9.0								20.2				
LSS - 15	10.0								21.9				
LSS - 16	2.0	49	21	28	9.5	73	A-7-6 (20)	CL	18.1				
LSS - 16	3.0								18.9				
LSS - 16	4.0								21.5				
LSS - 16	5.0								21.2				
LSS - 16	6.0								21.7				
LSS - 16	7.0								20.8				
LSS - 16	8.0								20.5				
LSS - 16	9.0								19.9				
LSS - 16	10.0								20.6				
LSS - 17	2.0	47	20	27	9.5	69	A-7-6 (17)	CL	6.2				
LSS - 17	3.0								18.0				
LSS - 17	4.0								21.7				
LSS - 17	5.0								16.4				
LSS - 17	6.0								20.8				
LSS - 17	7.0								20.5				
LSS - 17	8.0								20.9				
LSS - 17	9.0								21.6				
LSS - 17	10.0								21.8				
LSS - 18	2.0	45	19	26	9.5	32	A-2-7 (3)	SC	14.2				
LSS - 18	3.0								16.5				
LSS - 18	4.0								17.1				
LSS - 18	5.0								17.3				
LSS - 18	6.0								21.0				
LSS - 18	7.0								21.7				
LSS - 18	8.0								21.4				
LSS - 18	9.0								20.4				
LSS - 18	10.0								20.8				
LSS - 19	2.0	46	21	25	9.5	71	A-7-6 (17)	CL	20.1				
LSS - 19	3.0								18.6				
LSS - 19	4.0								19.4				
LSS - 19	5.0								17.4				
LSS - 19	6.0								19.7				
LSS - 19	7.0								25.0				
LSS - 19	8.0								21.4				
LSS - 19	9.0								21.3				
LSS - 19	10.0								19.4				